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Review Article

Store in nature - A medium for avulsed tooth

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ABSTRACT

Avulsion of tooth is complete displacement of tooth out of its socket that leads to mutilation of periodontal ligaments. The desirable treatment option is replantation of the tooth. However, unsuccessful replantation is a matter of great discontentment. Protection of teeth from desiccation (drying of the periodontal ligament tissue), by keeping it in storage media can improve the result of the treatment. Ability to maintain periodontal cell viability for a longer time is warranted in cases of major accidents, where teeth can be replanted only after other major surgeries. This paper reviews the different storage media that have been used for avulsed teeth based on full-length research papers retrieved from GOOGLE search using the key words 'storage medium', 'avulsion', 'tooth avulsion', 'replantation', 'tooth replantation', 'milk' , 'propolis', 'coconut water', 'pomegranate' and natural products. Natural products have easy availability, greater efficacy and longer storage time as compared to Hank's balanced salt solution which has been recommended by the International Association of Dental Traumatology as standard solution for storage of avulsed teeth. In case of emergency, it is important for dentists to consider the circumstances of the accident, the location and suggest an appropriate Natural transport/storage medium for the avulsed tooth which score better over the Hank's Balance Salt Solution, based on their storage time, ease of availability and economical price.

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1. Introduction

Tooth avulsion is the complete loss of tooth from the alveolar socket due to trauma[1] and it may result in the early loss of teeth, leading to aesthetic, functional and psychological problems. Avulsion of permanent tooth is the most serious traumatic tooth injuries of all types because of the complete dislodgement of the tooth from its socket causing severe damage to the supporting tissues, vascular and nerve structures.[2,3] Prevalence of this type of injuries is between 1% and 16% involving the permanent dentition.[4–6] The most frequently affected age group by this type of injury is between 7-10 years, they are excessive involvement in sport activities because of their playfulness, the characteristic of this age group. The prognosis of a replanted tooth depends on the viability of the periodontal ligament (PDL) cells remaining on root surface, integrity of root cementum and contamination,[7] minimal bacterial which are the conditions directly related to the extra-alveolar time, type of storage after avulsion and root surface alterations. Immediate replantation of avulsed tooth into its socket is the ideal treatment.

Factors influencing the success of replantation are age, width and length of root canal, mechanical damage during avulsion and replantation, splinting of the replanted tooth, effect of mastication, extra-alveolar duration and storage media.[8] According to Andresen, the replantation of teeth beyond five minutes of avulsion is considered as delayed replantation.[9] In cases of delayed replantation, the avulsed tooth should be stored in appropriate media, which can

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prevent desiccation and subsequent loss of vitality of PDL.[10]

The storage media for an avulsed tooth should have ideal characteristics. Most widely used and recommended standard solution by the International Association of Dental Traumatology as a storage medium for avulsed teeth is HBSS.[11] It is not readily available and also costly. Hence, need for the other accessible, easy available and affordable storage media is in the search. This article focuses on natural products used as a storage media for avulsed teeth which is easy available.

1.1. Storage media

The ideal storage medium should preserve the majority of the functional capacities of the cells of the periodontal ligament. Out of various storage media available, Hanks balanced salt solution is the preferred storage media, which preserves the components of tissue in its normal physiological conditions.[12,13]

1.2. Ideal characteristics of Transport (Storage) Media[14]

1. It should maintain viability of periodontal fibres.
2. It should be clonogenic and mitogenic capacity.
3. It should have physiological osmolarity and pH.
4. It should not have antigen antibody reactions.
5. It should have less risk of root resorption.
6. It should be effective under different conditions.
7. It should have antimicrobial property.
8. It should stimulate the dental alveolus.
9. It should have antioxidant property.
10. It should have easy availability.
11. It should be readily accessible.
12. It should have low cost.

Thus these key factors plays a very important role in determining the overall efficacy of a transport medium, and hence should be given due consideration.

1.3. Different natural products used as storage media

1.3.1. Milk and milk products

Milk is the most easily available medium. Milk has several highly favorable characteristics to be used as a storage medium. Milk is significantly better than other storage media for its physiologic properties, compatible to those of the periodontal ligament cells, the easy way of obtaining it and for being free of bacteria, but it is important that it should be used with in the first 20 minutes after avulsion. The favorable results of milk as a storage media is due to presence of nutritional substances such as amino acids, carbohydrates and vitamins. It has low or no bacterial content. It contains growth factors and essential nutrients for cells. It has a high and easy availability and it has low cost.[15–17] The periodontal ligament cells have a survival rate of 70 to 90% and lower frequency of root resorption even after periods up to 72 hours. Blomlof et al.,[18] recommend milk as an excellent storing solution for 6 hours; however, milk cannot revive the degenerated cells.

1.3.2. Propolis

Propolis is a natural substance produced by honeybees. It is a red or brown resinous substance collected by honeybees from tree buds, used by them to fill crevices and to fix and varnish honeycombs. Depending on the sources it can be found in green, red, black, and white hues but normally, it is dark brown in color. It has antioxidant, anti- inflammatory and antimicrobial properties.

1.3.3. Uses[19,20]

1. Propolis is used as traditional medicines, treating cold sores, genital herpes, and post-surgery mouth pain.
2. Scientific evidence showed in vitro antibacterial and antifungal activity in some types of Propolis because of their active constituents including flavonoids like galangin and hydroxycinnamic acids like caffeic acid.
3. Propolis is effective in treating the skin burns, It has been reported that Propolis exhibit both immunosuppressive and immunostimulant effects.
4. Due to its antimicrobial properties it protect against dental caries and other forms of oral disease,
5. Propolis can possibly induce cell cycle arrest, apoptosis and reduces expression of growth and transcription factors, including NF-κB. Notably, caffeic acid phenethyl ester down regulates the mdr-1 gene, considered responsible for the resistance of cancer cells to chemotherapeutic agents.

Ozan et a.,[21] have analyzed the properties of Propolis as a storage medium for the maintenance of cellular viability of the periodontal ligament cells of the avulsed tooth and concluded that it can be considered as a favorable storing medium for the fact that it has anti-microbial properties. For this reason, it maintains the cellular viability of the periodontal ligament cells, besides being anti-microbial, anti- inflammatory and anti-oxidant properties. Ideal period for maintaining avulsed tooth in Propolis is about 6 hours as the efficacy of the medium increases as contact with the product increases, which is beneficial for cell maintenance.

1.3.4. Egg white

Egg white is the common name for the clear liquid (also called the albumen or the glair/glaire) within an egg. The primary purpose of egg white is to protect the yolk and provide additional nutrition for the growth of the embryo (when fertilized). Egg white is an alkaline solution and contains approximately 40 different proteins. This medium is considered a good choice for teeth undergoing delayed replantation due to its high content of proteins, vitamins

and water. There is absence of microbial contamination. It is easily available, provides cell viability and histological characteristics similar to those of milk. When compared to milk, egg white as solutions for storage medium of avulsed teeth have shown that teeth stored in egg white 6 to 10 hours had better incidence of repair and lower surface resorption for same amount of time. The osmolality of egg white is between 251 to 298 mOsm/kg.[22]

1.3.5. Coconut water

The coconut (Cocus nucifera L) is a plant that flowers monthly. Coconut water is a naturally occurring biologically pure and sterile product. It is rich in amino acids, proteins, vitamins and minerals. It has been widely consumed to replace fluids, electrolytes (potassium, calcium and magnesium). The story of coconut water usage as intravenous rehydration fluid originated during World War II when coconut water was given intravenously to British and Japanese patients in emergency because saline was unavailable and coconut water was being similar to human blood plasma. Coconut water is used in the treatment of diarrhea in folk medicine practices. Excessive consumption of coconut water causes hyperkalemia, acute kidney failure, heart arrhythmia, loss of consciousness and eventually death also.[23]

Coconut water is shown to have kept significantly more periodontal ligament cells viable compared to Hank's balanced salt solution, milk or Propolis. According to Ali S et al.,[24] Full concentration mature coconut water was superior to 50% dilutions obtained from either young or mature coconuts. It is easily available and is not very expensive. Hence coconut water can be used as a suitable storage medium for avulsed teeth.

1.3.6. Aloe vera extract

Aloe Vera is a member of Liliaceae family. It is a medicinal plant which is cactus like with green, tapered leaves that are filled with transparent viscous gel. This gelatinous substance contains 96% water and 75 other active properties like vitamins, minerals, enzymes, sugars, salicylic acid and amino acids. It has been reported that Aloe Vera has significant anti- inflammatory, antioxidant, antibacterial, antifungal and anti-carcinogenic activities. It also has a great wound healing effect as it contains essential nutrients for cell survival.[25] According to Badakhsh et al., aloe vera 10%, 30% and 50% concentrations may be recommended as a suitable alternative storage media for avulsed teeth.

1.3.7. Green tea extract

Green Tea, extracted from Camellia sinensis, is a widely consumed beverage throughout the world, that only second to water. Green tea extracts contain catechin, which is one of the polyphenols from green tea. The other polyphenols are epicatechin, epicatechin gallate, epigallocatechin, epigallocatechin-3-gallate and so forth. Epigallocatechin-3- gallate is known to protect the alveolar bone resorption from periodontal diseases it inhibited the expression of matrix metalloproteinase-9 in osteoblasts and the formation of osteoclasts. Also it suppresses the progression of apical periodontitis, possibly by diminishing osteoblastic expression of cysteine-rich[26] and subsequently macrophage chemotaxis into lesions.

According to Hwang et al., efficacy of Green tea extract in maintaining the viability of human PDL cells was similar to that of Hank's balanced salt solution and better than that of milk. Hence Green tea extract can be used as an alternative media for the storage of avulsed teeth in case of absence of Hank's balanced salt solution.[27]

1.3.8. Pomegranate juice

Pomegranate is the fruit of Punica granatum (Puniceae). It has extensively been used in folk medicine of many cultures. Pomegranate is a rich source of polyphenolic flavinoids; which possess direct antioxidant properties, such as radical scavenging ability and indirect antioxidant properties such as induction of endogenous antioxidant enzymes. They also have anti- inflammatory properties such as restriction of low stimuli activation of inflammation, and antibacterial properties. The effects of fruit and peel extracts have a significant effect on proliferation and differentiation of osteoblasts, improved the pocket depth level of attached gingival and bleeding on probing in gingival pockets.

Punicalagin is the major antioxidant polyphenol ingredient in Pomegranate juice. Due to these anti-elastase and anti-collagenase activity of pomegranate juice, strong attachment of cells may occur. Due to these antioxidant, anti- inflammatory and antibacterial properties, Pomegranate juice can be used as an effective medium for storage of avulsed teeth for a long duration of time.

According to Tavassoli-Hojjati et al,[28] 7.5% concentration of Pomegranate juice is the most effective solution for maintaining PDL cell viability when compared to other solutions (1%, 2.5% and 5% pomegranate juice, HBSS and tap water).

1.3.9. Red mulberry juice

Mulberry belongs to genus Morus of family Moraceae. This fruit is found in temperate to subtropical regions of northern hemisphere to the tropics of the southern hemisphere. They can grow in a wide range of climatic, topographical and soil conditions. This fruit is used in variety of fields. Many people believe that deep-colored fruits, especially black and red mulberry fruits are healthier for the human body. They are eaten fresh, also used in marmalades, juices, natural dyes, liquors, in cosmetic industry. They are also said to have medicinal values. They are used as a worming agent, as a remedy for dysentery, and as a laxative, odontalgic, expectorant, hypoglemic and emetic.

According to Ozan et al.,[29] 4.0% concentration of red mulberry juice showed significantly better results than other solutions (2.5%, 1.5% and 0.5% red mulberry juice, Hank's balanced salt solution, saline and tap water) at all times.

2. Conclusions

Natural Transport/storage media score better over the Hank's Balance Salt Solution, based on their storage time, ease of availability and economical price. In case of emergency, it is important for dentists to consider the circumstances of the accident, the location and suggest an appropriate transport medium for the avulsed tooth.

3. Conflicts of Interest

All contributing authors declare no conflicts of interest.

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None.

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